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VOL. 100 FRIDAY, SEPTEMBER 29, 1944 No. 2596

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SCIENCE: A Weekly Journal devoted to the Advancement of Science. Editorial communications should be sent to the editors of SCIENCE, Lancaster, Pa. Published every Friday by

THE SCIENCE PRESS

Lancaster, Pennsylvania

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building, Washington 25, D. C.

PERSONNEL CLASSIFICATION TESTING IN THE ARMY

By Dr. WALTER V. BINGHAM

CHAIRMAN OF COMMITTEE ON CLASSIFICATION OF MILITARY PERSONNEL
ADVISORY TO THE ADJUTANT GENERAL[1]

INTRODUCTION

THE Committee on Classification of Military Personnel, appointed by the National Research Council at the request of The Adjutant General in May, 1940, has completed four years of advisory service. These years have seen striking changes in the nature and scope of the technical problems involved in classifying and assigning officers and men as the Army has entered on successive phases of planning for the national defense, mobilization, swift expansion, participation in a world-wide war and return of service personnel to civilian employment. A short sketch of what has been done during this period will introduce a summary of activities within the past year.

[1] The membership of this committee at the time of its appointment by the National Research Council included also C. C. Brigham, H. E. Garrett, L. J. O'Rourke, M. W. Richardson, C. L. Shartle and L. L. Thurstone. Following the untimely death of Dr. Brigham on January 23, 1943, C. F. Hansen was designated as his successor.

RETROSPECT

Four months before the Selective Service and Training Act was passed in September, 1940, The Adjutant General had asked the committee what steps should be taken to provide aids to general personnel classification and appraisal of soldierly potentialities of recruits and inductees. The question took this form: Should reliance be placed on the standardized vocabulary tests then in use at recruiting stations as aids in sizing up the military suitability of volunteers? Or should use be made of available revisions of Army Alpha, Army Beta and the Binet-Simon Scale? Or had the time arrived to prepare new tests for purposes of screening and initial classification?

It seemed clear that a new general classification test was required, and also an examination which could be given to non-English-speaking men and to illiterates. Tests of aptitudes for training in clerical duties and in mechanical occupations also seemed to be indicated.

To help in meeting these needs was the chief task of the committee in 1940.

During the summer of that year, The Adjutant General established a Personnel Research Section,[2, 3, 4] called to temporary active duty three psychologists who held reserve commissions, and secured through the machinery of the U. S. Civil Service Commission the appointment of five civilian psychologists classified as personnel technicians. Clerical aid was at first almost non-existent. For several weeks until additional funds were authorized, the chief reliance was on NYA students who came to work on alternate days. Agencies such as the Civil Service Commission, the Bureau of Public Health and the CCC helped out. The Occupational Analysis Section of the U. S. Employment Service assisted greatly by analyzing and concisely describing the more important military occupations, by helping to revise and structuralize the Army's occupational code of civilian and military specialties, and by making available for Army use a volume of Oral Trade Questions to help interviewers in finding out whether a soldier was really as well informed about his trade as he claimed to be.

In preparing new tests, the usual procedures of test construction, try-out, item analysis, tentative validation, calibration and comparison with other tests were carried forward. Data for use in scaling and standardizing the Army General Classification Test were then secured from a population of about five thousand men—mostly soldiers of the regular Army together with some CCC boys, graduate students and a few institutionalized men. In the statistical treatment of these data, the variables of age, schooling and geographical region were roughly controlled, with the intention of locating the mid-point of the Army scale at "the central tendency of the distribution of scores made by the adult white male population of military age," a target which was not missed very far, as events have proved.

On November 18, 1940, when the first selectees reached the Army Reception Centers from the Induction Stations, the Army General Classification Test, the Non-Language Examination 2 abc and the Soldiers Qualification Card, W.D., A.G.O. Form 20, had been printed and distributed, ready for use.

Since that time, one of four forms of the Army General Classification Test has been taken by approximately eight million men and the scores entered on their Qualification Cards along with data about age, schooling, occupational experience and other items of information which bear on the question of the individual's maximum field of usefulness within the Army. About six million of these cards contain also the soldiers' scores on a test of mechanical aptitude. Half as many carry records of performance in a radiotelegraph operator aptitude test, while smaller numbers tell what the soldier has done when given a chance to take a test of clerical aptitude or to show what he could do on one or more of a variety of special qualifying tests.

The members of the committee were gratified to observe that such aids to personnel classification proved useful in the task of rapidly balancing the distribution of talents throughout the arms and services. Perhaps their chief cause for anxiety has been a tendency on the part of some officers to place undue reliance on test scores alone as indicators of ability to learn and to perform.

During 1941, a need was increasingly recognized for procedures and tests to assist in identifying soldiers with exceptional aptitudes for learning a particular military specialty such as bombardier, weather observer, combat intelligence trainee or motor vehicle maintenanceman. Suitable tests were prepared[5] according to a pattern of development, standardization, calibration and validation which conformed with the committee's suggestions and which have proved their worth by economizing personnel and training time. In July of that year, the Air Surgeon established a psychological branch for research on selection of air personnel. Since then this branch has studied in great detail four of the military occupations: pilot, navigator, bombardier and aerial gunner.[6]

Recent Developments

Extension and improvement of the Army-wide testing program has been one of the continuing responsibilities of the personnel research staff of the Classification and Replacement Branch in the Adjutant General's Office. This group has grown from the modest beginnings already described until it consists of 21 officers and 45 civilian members of the professional staff who have the help of 51 clerical assistants and about 50 expert consultants who serve part time. They have kept the Committee on Classification of Military Personnel informed of accomplishments and of problems which they have had to face. The following paragraphs deal with problems which absorbed a good deal of attention during the past year and were discussed in detail by the committee at its eleventh meeting, May 26 and 27, 1944.

[2] Walter V. Bingham, *et al.*, SCIENCE, 93: 572–574, 1941.

[3] Walter V. Bingham, *Ann. Amer. Acad. Pol. Soc. Sci.*, 219: 18–28, 1942.

[4] *Personnel Research in the Army:* A series of six articles by the Staff, Personnel Research Section, Adj. Gen. Office. *Psychol. Bull.*, 1943, 40, 129–135, and succeeding issues.

[5] R. W. Faubion and R. M. Bellows, *Psychol. Bull.*, 39: 643–664, 1942.

[6] John C. Flanagan, *Jour. Consult. Psychol.*, 6: 229–240, 1942.

Psychological Screening at Induction Stations. To identify correctly all the marginally suitable selectees during a pre-induction examination is no easy matter. The aim is to admit illiterates who are bright enough to be trained in military duties while excluding literates who are so dull and slow that it is not feasible to train them to be useful soldiers. For more than a year and a half after procurement through Selective Service began to replace the traditional system of voluntary recruitment, final decisions as to mental qualifications of registrants selected by local boards for induction were made by officers in command of the induction stations, after considering any evidences of mental deficiency observed in the course of a test of literacy and in a brief interview conducted by an examining psychiatrist. Not until August 1, 1942, were psychological examinations for screening the extremely dull adopted for nation-wide use in induction stations. Thereafter, selectees whose schooling had not reached the level of high-school graduation were screened by psychologists (personnel consultant officers) who used a very brief interview and a battery of group tests, verbal and non-language, supplemented when necessary by individual examinations. For a time, limitations were imposed on the number of illiterates accepted. But, schooled in the Army's Special Training Units, most of these men picked up the indispensable minimum of proficiency in reading and figuring in from eight to twelve weeks; and on June 1, 1943, all restrictions on acceptance of illiterates were removed, provided they met the established standards of mental ability. These tests and procedures have again been thoroughly revised, the better to identify and bar out the mentally deficient while admitting bright illiterates. This new battery of induction station tests has recently been adopted after having been thoroughly validated against the practical criterion of minimum ability to perform as a soldier.

Army Basic Abilities Test. A test of wide applicability projected in 1942 to take the place of the Army General Classification Test and certain other tests as well has only now reached the final stages of standardization. Besides an overall measure of general learning ability, it yields a profile of significant measures of specific abilities, including reading and vocabulary, arithmetical reasoning, computation and space thinking.

Army Individual Test. The need for tests of mental ability for use in hospitals, detention barracks, mental hygiene clinics, special training units and discharge boards where a paper-and-pencil group test is not suitable or adequate has generally been met through the use of well-known tests and scales, supplemented by new devices and adaptations provided by F. L. Wells, David Wechsler and others. During the past year, the Personnel Research Section has developed and validated an individual examination which has several advantages in the way of simplicity of procedures, number of subtests and amount and variety of materials the examiner has to handle. It eliminates reference to unsuitable forms of interpretation such as "Mental Age" and "Intelligence Quotient"—concepts which, no matter how valuable they are in thinking about rate of mental growth, are not suited to the expression of differences in mental ability among adults. The committee finds this Army Individual Test to be administratively workable and well adapted to military requirements, and has recommended its adoption for use in situations where a group test is inappropriate, although much remains to be ascertained as to the precise clinical significance of the total and partial scores.

Measures of Mechanical Aptitudes. The advice of the committee has been needed particularly, during the past twelve months, in connection with problems of selecting men for training in mechanical occupations, for example, airplane engine mechanic, automotive maintenanceman, armorer, radar technician and radio repairman. A question had arisen in certain military circles as to the advisability of measuring mechanical aptitudes by means of paper-and-pencil tests such as those which had been widely used for two years. "Is it not obvious," said these officers, "that a still better way of finding out about a man's mechanical ingenuity and resourcefulness is to give him a manipulative test, a gadget which he must take apart or put together?" About sixty such performance tests were, as a matter of fact, locally devised by diligent officers, most of whom were not fully aware of the necessity for rigorous experimentation and try-out to make certain that a test which looks ingenious and promising actually yields scores which are differentiating and reliable enough to be depended upon, and which are significantly related to subsequent performance. When called upon to examine these new tests, to report on their usefulness in comparison with other indicators of probable success, and to provide, if possible, still better predictors, the personnel research staff of the Adjutant General's Office asked the Committee on Classification of Military Personnel for advice and suggestions. In response to this request a subcommittee, authorized by the Division of Anthropology and Psychology of the National Research Council, was appointed and given the title, "Advisory Board on Mechanical and Technical Personnel."

The membership of this board is as follows: Dr. C. L. Shartle, *Chairman,* chief of the Division of Occupational Analysis and Manning Tables, War Manpower Commission; Dr. H. A. Edgerton, director of the Occupational Opportunity Service, Ohio State

University; Dr. J. L. Otis, director of the Personnel Research Institute, Cleveland College, Western Reserve University; Dr. Millicent Pond, Industrial Personnel Division, Army Service Forces, formerly director of Psychological Test Research, Scoville Manufacturing Company; Dr. Joseph Tiffin, professor of psychology, Purdue University.

The board held its first meetings on the second and third of July, 1943. A tour was made of Ordnance Schools and a Replacement Training Center in the Baltimore area in order to become familiar with the prevailing problems of classification, after which the board recommended that improvements in the correctness and adequacy of criterion data should be given first attention. Better ratings and evaluations by school instructors of progress made by trainees in service schools were urged. The board also called for a reduction in the number of different classification tests used in certain training centers and for introduction of simpler classification devices of known dependability.

Moving in the direction suggested, the Technical Classification Unit of the Personnel Research Section carefully ascertained the reliability of each of the more promising performance tests of mechanical aptitude which had sprung up. Few of them were found to be reliable enough to warrant serious consideration as items in a predictive battery. None was as valid as the better paper-and-pencil group tests of mechanical aptitude. As a consequence of this and related studies, twenty-five manipulative tests formerly administered in Army Air Forces Basic Training Centers in order to select personnel for technical aircraft maintenance courses were replaced by a battery of four objectively evaluated tests, only two of which are performance tests. Use of this battery has reduced substantially the proportion of failures in these courses. An estimate of savings in training costs effected by this particular study is $57.50 for each man processed through these Basic Training Centers. Incidentally, it was no surprise to the board to find that the mechanical aptitudes required for successful completion of these training courses are sampled more accurately by means of well-constructed paper tests of space thinking and mechanical comprehension than by so-called "practical" manipulative tests, for in the latter, a man's performance tends to vary not only with his mechanical understanding and ingenuity; it is affected also to a conspicuous degree by his manual dexterity, his mere skill of hand; and such purely manual factors are of relatively trivial moment in predicting ability to learn how to adjust a propellor, to repair a balky machine gun, or to diagnose and cure an attack of engine trouble.

Follow-Up. At subsequent meetings on August 13 and 14, 1943, and on December 10 and 11, 1943, the board reviewed the progress that had been made and offered further suggestions. Deploring the tendency to evaluate tests solely in terms of their validity as predictors of performance in service schools, a strong recommendation was filed urging that follow-up data be secured from combat units. As a consequence, the personnel research staff has secured and studied ratings of performance of mechanics and technicians serving with airplane spotter and anti-submarine units on duty in this country, and efforts are being made to secure from foreign theaters of operations similar follow-up information.

Measures of Proficiency. Facts regarding the actual proficiency of mechanics, technicians and other specialists are indispensable for correct assignment. But estimates of such proficiency, made by classification interviewers, by instructors in specialist training courses and by assignment officers, are sometimes quite inaccurate. For this reason it has been necessary to develop objective tests of knowledge and performance in those specialties which are of the greatest importance numerically or otherwise. For example, automotive repairmen are called for in large numbers throughout the services; it is essential to know just what kinds of truck-maintenance work can be entrusted to each man. Proficiency tests have been developed for this occupation, and for other common specialties such as cook, baker, clerk, carpenter and painter; also for nearly fifty other specialties which occur less frequently but are nevertheless vital to military operations, as in the ground-crews of the Air Forces.

These tests have served several purposes. They have been employed to evaluate the proficiency obtained in service schools and by experience on the job, with a view to accurate assignment. They have been used to minimize duplication in retraining, to shorten the time required by ascertaining those items or phases of instruction which certain individuals can by-pass since they already have the prescribed skills or information. They have served to measure the rate of progress and to supply the incentive of competition. And finally, for the program of selection research, they have furnished invaluable criterion data.

Night Vision. The measurement of individual differences in dark-adaptation and the ability to see in extremely low illumination is obviously important in selecting men capable of serving on night patrols or as scouts, lookouts and drivers responsible for leading convoys of trucks during the darkest hours. (See Fig. 1.) Most of the instruments for measuring dark-adaptation have proved to be unreliable or impractical

to use under camp conditions. To meet this situation, a dark-adaptation test has been developed which meets the requirements of simplicity, practicality and reliability. It has now been twice validated in infantry and field artillery training centers against field criteria of ability to see at night. This test apparatus has, moreover, proved to have utility as a training instrument as well as for selection.

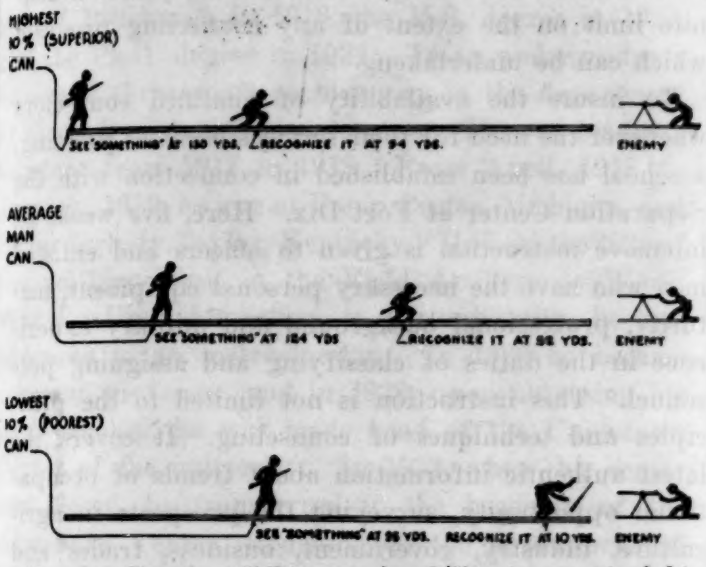

FIG. 1. Showing differences in ability to see at night. Based on data secured on dark starlit nights from four hundred and fifty soldiers in a training center.

Personality Tests. Requests have repeatedly been received for various kinds of personality tests. Projective techniques, personal inventories and other forms of test have been in demand. They are wanted as screens to identify men who should be drawn to the attention of a psychiatrist; as aids in diagnosing maladjustments; or as measures of characteristics deemed important for success in such military occupations as paratrooper. They have been requested by induction stations, special training units, mental hygiene clinics, hospitals, convalescent wards, rehabilitation centers and reassignment depots. Psychologists called upon to testify before a discharge board or a court martial have wanted objective measures of personality with which to buttress their opinions. Instructors training embryo officers, and boards passing upon the relative suitability of applicants competing for admission to officer candidate schools have longed for yardsticks with which to measure what it takes—in addition to intelligence and physical stamina—to lead a platoon to victory in battle.

This field of personality measurement is a difficult and baffling one. Attempts have been made in several of the situations mentioned above to validate and utilize those instrumentalities which appeared to be most promising. But the outcome has generally been unsatisfactory. The test scores are seldom reliable enough to be depended upon for individual diagnosis, or they are complicated, difficult to secure and ambiguous in interpretation. In one situation it turned out that a greater amount of dependable significant information could be obtained at less cost of time by close observation and careful proficient interviewing of the individuals in question than by giving, scoring and interpreting the proposed tests of personality. The Committee on Classification of Military Personnel has, nevertheless, recommended a continuation of current studies to determine the practicality and immediate usefulness of several tests, inventories and projective techniques so that the results may be made known throughout the Army, even though they should turn out to be disappointingly negative.

Selection of Combat Leaders. It is not difficult to measure ability to learn what is taught in officer candidate school. This is now done by means of a forty-five minute Officer Candidate Test, required of each applicant before he appears for interview by the members of a selection board. To predict his success as an instructor and disciplinarian of the soldiers in a platoon is much harder. The pay-off—his success in leading these men when he and his troops are under fire—is even harder to forecast.

Ability to maintain a clear head under conditions of extreme stress has long been recognized as one of the weighty factors in combat leadership. It is therefore not surprising that proposals for officer candidate selection tests have frequently included resort to standardized stress situations which provide for measuring the candidate's ability to maintain his self-command and to think and act sensibly in spite of intense distractions. Such methods, employed with apparent satisfaction in both the British and the German Armies, have not been favorably considered for general adoption in this country. To be sure, trial in at least one officer candidate school has given favorable results; but up to the present time it has been deemed inadvisable to extend experimentation of this sort, partly because of the likelihood of widespread misunderstanding of the use of obviously artificial stress situations; and partly because it has seemed to be feasible to reach the same goal by accumulating the facts about a candidate's achievements and behavior as observed under the real stresses that normally arise during an extended period of military training, for example, when the soldier is experiencing the excitement of his first infiltration exercise with live ammunition, or when he is being introduced to the poison gas chamber.

In the meantime, Henry E. Garrett, with the help of Ernest M. Ligon, has studied the current methods of evaluating leadership in Infantry and Field Artil-

lery Officer Candidate Schools. He has also been able to examine ratings made upon 176 company officers (mostly lieutenants) who are graduates of the Infantry School at Fort Benning and who led their men through the stress of battle in a foreign theater of operations. These combat efficiency ratings are related—though not closely—to the leadership ratings that had been assigned to these men by their platoon instructors in Officer Candidate School. It was noted that company officers between the ages of 22 and 27 tend to be rated more efficient in combat than younger or older men. Entrance requirements for this Officer Candidate School could, it seems, be established in a way to eliminate many men who, although they could graduate, would subsequently prove to be inefficient officers. In order to define these standards precisely, however, more data are needed. And so the committee's earlier recommendations have been urgently renewed, that combat efficiency ratings be obtained upon a large number of company officers and non-coms in a theater of operations where these men have recently been leading platoons or sections under enemy fire. It seems that the study of such information in relation to the facts available about these men at the time when they were being considered for officer candidate school would now furnish the most promising approach to a solution of this difficult problem.

Separation Classification. The committee has expressed its satisfaction at the progress made since June, 1943, in improving procedures for classification and vocational counseling of personnel about to be separated. But much remains to be done before X-Day when the volume of separations will be enormous.

For example, as one aid in the training of officers to be vocational counselors, the committee has stressed the desirability of ascertaining now the facts as to the relationships between Army test scores and fields of civilian occupational specialization. It has seemed advisable to find out the spread and the central tendency of test scores in each of the more common occupations. Studies under weigh will show also the meaning of different scores in estimating the probability of educational success in trade school, high school, technical school, college and professional school, as well as in occupational specialties. This information is being obtained by tabulating data from a large sample of Qualification Cards.

It is recognized that the Army's responsibility for the vocational counseling of its personnel can be met only if certain conditions prevail. In the first place, counseling should be available at a time when the man has an appetite for it and the leisure to think through his personal plans in the light of information which his counselor provides. It is a preparation for return to civil life. This suggests that the counseling should be initiated well in advance of the final hectic day of discharge. Moreover, counselors chosen for this assignment must have certain indispensable personal qualifications as well as the essential professional background of training and experience. The number of such officers is not great. This fact places a definite limit on the extent of any counseling program which can be undertaken.

To insure the availability of qualified counselors whenever the need for their services becomes pressing, a school has been established in connection with the Separation Center at Fort Dix. Here, five weeks of intensive instruction is given to officers and enlisted men who have the necessary personal equipment, maturity, professional background and military experience in the duties of classifying and assigning personnel. This instruction is not limited to the principles and techniques of counseling. It covers the latest authentic information about trends of occupational opportunity, surveying the prospects in agriculture, industry, government, business, trades and professions. The facts about facilities for further education are supplied; also about the civilian agencies to which a returned serviceman may turn for further guidance if desired, and for help in securing just the right job or in undertaking the most suitable course of training.

The committee and the officers with whom it has conferred are under no illusions as to the possibility of supplying any final or definite vocational counseling to men who face the transition from military to civilian status. Instead, the need has been seen for making available to soldiers who request them, some of the facts without which their first steps toward planning their subsequent careers are likely to be all too casual—facts about themselves and their abilities as well as about the situation in fields of occupation to which an adjustment must eventually be effected. In other words, the task is not immediate job placement, a civilian function. It is orientation.

In so far as the military personnel classification service succeeds in meeting this need for competent educational and occupational counseling, it will, the committee thinks, have boxed the compass of its obvious responsibilities in selecting, differentiating, distributing, reclassifying and utilizing the manpower the nation has supplied, and providing a helpful hand to citizen soldiers when, after military victory, they think about turning in their weapons to take up again the tools of industry.

OBITUARY

KENDALL SIEBERT TESH

ON Wednesday, August 9, preparatory to giving an examination to one of his classes, Kendall Siebert Tesh died suddenly at his desk in the department of chemistry of the University of Pittsburgh, where he began teaching as an assistant in his senior year in 1917. He obtained the B.S. degree from the University of Pittsburgh in 1918, the M.S. degree in 1921, and the Ph.D. degree in 1924. As an undergraduate he served three years as secretary in the department of chemistry, earning his education. He was graduate assistant from 1917 to 1918. From April, 1918, to January, 1919, he was at Camp Custer, Michigan, and Camp Zachary Taylor, Kentucky. He held the title of Second Lieutenant in the Field Artillery in World War I. Upon his return to the university, he was advanced to an instructorship. In 1926 he became assistant professor, and in 1928, upon obtaining his professorship, he was made head of the Uniontown Center of the university. In 1933, when this center was closed, he transferred to the headship of the Johnstown Center, returning to the department of chemistry in 1936 as professor of chemistry. Early during his teaching career, he was granted a year's leave of absence to engage in research in spectroscopy on a fellowship under Dr. B. S. Hopkins, of the University of Illinois.

Dr. Tesh was a member of Alpha Chi Sigma fraternity, Phi Lambda Upsilon, Epsilon Chi and Sigma Xi honorary fraternities. He was also a member of the American Chemical Society and the American Association of University Professors. He was a past president of the Faculty Club of the University of Pittsburgh.

Dr. Tesh is survived by his wife, Flora Hitzfelt Tesh; a brother, Robert Tesh, of Wilmington, Delaware; a sister, Mrs. A. H. Croup, of Erie; and another sister, Miss Sara C. Tesh, who is a teacher in Pittsburgh Public Schools.

ALEXANDER SILVERMAN

RECENT DEATHS

GEORGE LEROY GUILETT, since 1924 associate professor of mechanical engineering at Pennsylvania State College, died on September 18. He formerly taught at McGill and Queen's Universities in Canada.

DR. WALTER HUGHSON, associate in otology in the Graduate School of Medicine of the University of Pennsylvania, died on September 13 at the age of fifty-three years.

DR. WALTER SAVAGE LANDIS, vice-president of the American Cyanamid Company, died on September 15 at the age of sixty-three years.

SCIENTIFIC EVENTS

THE SUMMER MEETING OF THE AMERICAN MATHEMATICAL SOCIETY

THE fiftieth summer meeting of the American Mathematical Society was held at Wellesley College on August 13 and 14, in conjunction with meetings of the Mathematical Association of America and the Institute of Mathematical Statistics. The attendance was about three hundred, including two hundred and thirty-two members of the society. Rooms in the dormitories of the college and the Tower Court cafeteria were made available to the members of the three organizations, their families and guests.

The twenty-sixth colloquium was given by Professor Einar Hille, of Yale University. It consisted of a series of four lectures on "Selected Topics in the Theory of Semi-groups."

Professor C. C. MacDuffee, of the University of Wisconsin, gave an address by invitation "On the Composition of Algebraic Forms of Higher Degree."

Seventy-seven research papers were presented—twenty-seven in person and fifty by title. The society and the institute held a joint session for contributed papers on mathematical statistics.

At a dinner held on Sunday evening, Professor D. V. Widder was toastmaster. An address of welcome was given by Captain Mildred H. McAfee, U.S.N.R., president of Wellesley College, and an address, "American Mathematics in the Present War," by Professor Marshall Stone, president of the society. Professor J. S. Frame, on behalf of the three organizations meeting at Wellesley, presented a resolution of thanks to President McAfee, the local committee and all who assisted them for their excellent arrangements and cordial hospitality.

TEMPLE R. HOLLCROFT,
Associate Secretary, The American Mathematical Society

THE INSTITUTE OF BIOLOGY AND EXPERIMENTAL MEDICINE AT BUENOS AIRES

THE following communication has been addressed to members of the Federation of American Societies for Experimental Biology.

The undersigned, through communication with Professor Bernardo A. Houssay, of Buenos Aires, have

learned of certain urgent needs of this investigator and his devoted group of assôciates as regards adequate library facilities and especially access to our more important American journals in the broad field of medicine and biology. The group has been cut off from the excellent library built up by Professor Houssay and his staff and given to the University of Buenos Aires. Through the valiant behavior of certain Argentine citizens[1] and confrères, the Houssay group (which includes Drs. Lewis, Orias, Braun-Menendez and Foglia) has been able to set up a laboratory called the Instituto de Biologia y Medicina Experimental, Costa Rica 4185, Buenos Aires.

The Pacific Coast Branch of the Pan-American Medical Society has charged itself with sending complete files of the *Annual Reviews of Biochemistry and Physiology* and at least two years' subscriptions to the following:

The American Journal of Physiology
The Journal of Pharmacology and Experimental Therapeutics
The Journal of Biological Chemistry
The Journal of Nutrition

In a letter dated June 14 of this year, Dr. Houssay indicates his desire to secure at least current subscriptions to the following additional journals:

Endocrinology
The Journal of Experimental Medicine
Biological Abstracts
Acta Physiologica Scandinavica
The Quarterly Journal of Experimental Physiology (English)
Nutrition Abstracts
The Biochemical Journal (English)
The Journal of Endocrinology (English)
Physiological Reviews
The Archives of Biochemistry
The Journal of Laboratory and Clinical Medicine
The American Journal of Medical Science
The Annals of Internal Medicine
The Anatomical Record
Nature

It occurs to the undersigned that many American investigators will wish to contribute (from one to ten dollars) to a modest total sum to be used in this way as evidence of desire to assist a distinguished colleague and his associates. This action is suggested, not only as an expression of sympathy with these public-spirited men who have been penalized for merely stating their judgment as to the correct course of action for their country, but also and especially in recognition of the conspicuous capacity of the leader and his confrères to conduct critically founded investigations in the realm of physiology.

[1] See SCIENCE, 98: 467, 1942; 99: 166, 176, 360, 1944.

The committee subscribed is addressing members of the Federation of American Societies for Experimental Biology for individual cash subscriptions, however small, for this purpose and holds itself pledged to report in detail to contributors as to the amount and disposition of the fund which may be collected. The contributions may be sent to the chairman.

WALTER B. CANNON
CARL J. WIGGERS
JOHN F. FULTON
HERBERT M. EVANS, *Chairman*

THE MARINE BIOLOGICAL LABORATORY AND THE HURRICANE

THE many friends of the Marine Biological Laboratory, situated at Woods Hole, Mass., will be glad to learn that the institution came through the hurricane without serious harm. None of its books, apparatus or boats suffered in any way; nor were the buildings damaged except that some lost patches of shingles and many window panes. Although the tide was higher than normal, no sea water entered the Brick Building. Along the waterfront tremendous waves battered the sea wall, washed away a part of the greensward and covered the rest with sand and gravel. The old wharf, considered unsafe for some years, was almost completely destroyed. Repair of the buildings is going forward rapidly.

From the standpoint of investigators now working at the laboratory, the most serious effect of the storm is the loss of electricity to run the salt water pump, refrigerators and other apparatus, and to light the library at night. The cables bringing electricity to the Cape were carried down or broken by falling trees. To restore them is a slow task.

Contrary to many reports, there was no evacuation of the town, nor was any such measure considered for Woods Hole. However, residents of houses built on the beaches near Falmouth were told to leave before the storm broke. Many of those houses were demolished or badly damaged.

The hurricane of this year caused far less damage to the Marine Biological Laboratory than did the storm and flood of 1938.

CHARLES PACKARD,
Director

FELLOWSHIPS ESTABLISHED IN HONOR OF DR. FRANK B. JEWETT

THE American Telephone and Telegraph Company has established a trust fund to finance five annual post-doctorate fellowships in physical science "to stimulate and assist research in the fundamental physical sciences and particularly to provide the holders with opportunities for individual growth and development as creative scientists."

The fellowships are founded in honor of Dr. Frank B. Jewett, president of the National Academy of Sciences, vice-president of the company, in charge of development and research, who has reached the retirement age. They provide an annual honorarium of $3,000 to the holder and $1,500 to the institution at which the recipient elects to do research.

Seven members of the scientific staff of the Bell Telephone Laboratories will form a committee of award. The fellowships will enable the recipients to devote themselves to research in pure science for a year or two following receipt of their doctorates and will be awarded for demonstrated research ability and the fundamental importance of the problems proposed. They will be given to those who have obtained the doctorate within the preceding year, or who are expected to receive that degree not later than the beginning of the next fellowship term, which starts each July 1.

Selection for a fellowship award and its acceptance will involve no implication or commitment on the part of Bell Telephone Laboratories or on the part of the recipient as to later employment in the laboratories.

SCIENTIFIC NOTES AND NEWS

A DINNER was given on September 14 by the Section on Chemistry at the Cleveland meeting of the American Association for the Advancement of Science in honor of Dr. Hugh S. Taylor, chairman of the department of chemistry at Princeton University, retiring vice-president of the section.

DR. JOHN M. FOGG, JR., professor of botany and dean of the College of Arts and Sciences of the University of Pennsylvania, who was recently elected vice-provost of the university, will be the guest of honor and speaker on the evening of October 20 at the opening of the 1944–45 season of the Academy of Natural Sciences of Philadelphia. He will make an address entitled "The Greatest Expedition in the World," which will be followed by a reception and an exhibition of rare books on botany and travel in the library of the academy.

THE Medal for the Advancement of Research of the American Society for Metals, "awarded annually to the executive who has consistently sponsored metallurgical developments and by his foresight has helped to advance the arts and sciences relating to metals," will be presented at the annual dinner on October 19 at Cleveland to Robert Crooks Stanley, chairman and president of the International Nickel Company of Canada, Ltd., in recognition of "his pioneering leadership in the field of metals research."

THE American Society of Plant Physiologists has awarded the Charles Reid Barnes Life Membership to Dr. George William Scarth, MacDonald professor of botany at McGill University, and the bi-annual Stephen Hales Award to Dr. Ray Fields Dawson, assistant professor of botany at Princeton University.

REAR ADMIRAL RICHARD E. BYRD, who has been on active duty since the beginning of the war, has been cited by Secretary Forrestal for "outstanding performance of duty on two special missions in the Pacific war zone."

AN order from the headquarters of General Joseph W. Stilwell, commander of all U. S. Army Forces in the China-Burma-India theater, reads: "The bronze star is awarded to Major Joseph M. Ruggieri, U. S. Army, for meritorious services from April 4 to April 19, 1944." Major Ruggieri has since been promoted to the rank of lieutenant colonel. Before the war he was head of the science department and instructor in chemistry of the Board of Education, Woodbridge, N. J.

THE Rocky Mountain Biological Laboratory at its seventeenth annual meeting elected the following officers: *President of the Corporation,* Dr. A. O. Weese, professor of zoology, University of Oklahoma; *Vice-president,* Dr. B. D. Barclay, professor of botany, University of Tulsa; *Director of the Laboratory,* Dr. John C. Johnson, professor of biology, Pennsylvania State Teachers College, Edinboro; *Secretary,* Dr. George L. Cross, president of the University of Oklahoma, formerly professor of botany; *Treasurer,* Dr. J. Teague Self; reelected for a fourth term of five years a *member of the Board of Trustees,* Dr. A. Richards. Plans were made at the meeting to expand the work of the laboratory as soon as the war is over.

PROFESSOR CHARLES A. ELLWOOD, since 1930 professor of sociology in Duke University, after teaching university classes in sociology for forty-five years, will retire next June. Previously he had been for thirty years professor in the department of sociology of the University of Missouri. Professor Howard E. Jensen, who has been associated with Professor Ellwood at Duke University since 1931, has been appointed chairman of the department.

DR. ARTHUR C. COPE, associate professor of chemistry at Columbia University, has been appointed professor in charge of the division of organic chemistry of the department of chemistry of the Massachusetts Institute of Technology. Dr. Cope, who has under-

taken important war work, will be on leave of absence for the duration of the war.

NEIL P. BAILEY has been appointed head of the department of mechanical engineering at the Rensselaer Polytechnic Institute. He succeeds Edwin A. Fessenden, who will retire on October 31 after forty years of college teaching.

DR. CLINTON V. MACCOY, assistant professor of zoology at the Massachusetts State College, has been appointed to a similar position at Wheaton College.

DR. JAMES M. ORTEN has been promoted to an associate professorship of physiological chemistry at the College of Medicine of Wayne University. Dr. W. M. Cahill has resigned as assistant professor.

DR. S. J. WATSON, director in charge of the Jealott's Hill Agricultural Research Station of Imperial Chemical Industries, Ltd., has been appointed professor of agriculture in the University of Edinburgh and principal of the College of Agriculture of Edinburgh and the East of Scotland. He succeeds Professor Ernest Shearrer, who retires after eighteen years of service.

DR. SETH B. BENSON, assistant curator of mammals in the Museum of Vertebrate Zoology of the University of California, has been named curator of mammals and assistant professor of zoology.

RAYMOND BARRATT, assistant in research in the department of botany of the University of New Hampshire, has resigned to accept a similar position in the department of botany and plant pathology of the Connecticut Agricultural Experiment Station at New Haven.

ALTA GUSAR has been appointed curator of the Boas Memorial Collection in the library of Northwestern University. The collection consists of books and prints that made up the working library of the late Dr. Franz Boas, professor emeritus of anthropology of Columbia University.

DR. NORMAN F. CHILDERS, assistant professor of horticulture at the Ohio State University and associate in horticulture at the Ohio Agricultural Experiment Station, has taken up his work as assistant director and head of plant research at the U. S. Department of Agriculture Experiment Station at Mayaguez, Puerto Rico. David G. White, botanist with the Firestone Plantations Company, joined the staff as assistant horticulturist in July.

DR. J. HOLMES MARTIN, head of the poultry department of Purdue University, has a year's leave of absence to act as director of animal breeding research and consulting geneticist for the DeKalb Agricultural Association, Inc., Illinois. Dr. E. E. Schnetzler, assistant chief, will be acting head of the department during Dr. Martin's absence.

MAJOR GENERAL GEORGE C. DUNHAM, assistant coordinator of inter-American affairs, is visiting Managua, Nicaragua, to assist in the inauguration of the new public health building, erected with funds provided by the United States and by the Government of Nicaragua.

MAJOR ALFRED GOLDEN, M.C., of Madison, Wis., who has been on duty for the past four years at the Army Medical Museum, has been transferred to the Division of Health and Sanitation, Office of the Coordinator of Inter-American Affairs. Major Golden will be assigned to duty in Latin America to study the pathology of certain tropical diseases.

DR. HOWARD A. MEYERHOFF, professor of geology and geography at Smith College, who has been on leave during 1943–44 to teach army and navy personnel in the Foreign Areas Studies at Yale University, has returned to the college.

A CABLE from Guatemala to *The New York Times* states that Dr. Carlos Estevez, formerly director general of sanitation of Guatemala, has joined the Pan-American Sanitary Bureau for a study of filariasis. His headquarters will be in Mexico.

THE Edward de Mille Campbell Memorial Lecture of the American Society for Metals, following the annual meeting of the society at Cleveland, will be delivered by Dr. G. R. Fitterer, professor and head of the department of metallurgical engineering of the University of Pittsburgh, on the morning of October 18.

THE Seventh Annual Louis Gross Memorial Lecture will be delivered on October 25 at the Jewish General Hospital, Montreal, by Dr. Leo Loewe, of New York, whose subject will be "Further Observations on the Combined Use of Penicillin and Heparin in the Treatment of Subacute Bacterial Endocarditis."

SIR HAROLD WHITTINGHAM, British Air Marshal, gave on September 21 at the Royal Institute of Public Health and Hygiene, London, an illustrated address entitled "Aviation's Contribution to Preventive Medicine."

THE executive committee of the division of medical sciences of the National Research Council has voted unanimously to admit the American Society of Tropical Medicine to membership in the division.

THE International Congress of Philosophy convened on September 24 at Port-au-Prince, Haiti. It was the first such congress to meet in the Americas. The general subject chosen for the conference was "Les Problèmes de la Connaissance." Sixty specific subjects were listed for discussion, including Conscience and Knowledge, Materialism and Knowledge, Descartes and Knowledge, and Science, the foundation

of world unity. In spite of war conditions, representatives from France, England, Canada, the United States, Cuba, Mexico, Brazil, Peru and a number of other South American republics were present. Professor Jacques Maritain was the honored guest. The undertaking was the idea and work of Dr. Camille Lherisson.

A CONFERENCE on Parental Influence on the Incidence of Human Cancer was held from September 21 to 25 at the Roscoe B. Jackson Memorial Laboratory at Bar Harbor, Me., of which Dr. C. C. Little is director. This conference was made possible by the Rockefeller Foundation and Mrs. Albert Lasker.

THE Conference of Professors of Preventive Medicine will hold its second annual meeting on October 2 at the Hotel Pennsylvania, New York City. The morning session will open at 10:30 and the afternoon session at 2:30. Dr. W. G. Smillie, of Cornell University Medical College, will act as chairman, and Dr. L. W. Parr, of George Washington University, as secretary of the conference. The following subjects will be discussed: (1) Integration of the Teaching of Preventive Medicine with Clinical Teaching. Discussion to be opened by Dr. Jacques P. Gray, Medical College of Virginia. (2) Teaching of Industrial Hygiene in the Department of Public Health and Preventive Medicine. Discussion to be opened by Dr. Dwight O'Hara, Tufts Medical College. (3) Use of Teaching Films in Preventive Medicine and Public Health. Discussion to be opened by Dr. W. W. Peter, Yale University Medical School. (4) Teaching of Social and Economic Factors in the Department of Preventive Medicine. Discussion to be opened by Dr. Fred L. Moore, Long Island Medical College. (5) Teaching of Tropical and Parasitical Diseases in the Department of Preventive Medicine. Discussion to be opened by Dr. Henry E. Meleney, New York University College of Medicine. The leaders of the discussions will present their remarks in a 15-minute period, to be followed by a general discussion of each subject from the floor. At the conclusion of the afternoon program the report of the nominating committee will be received and such other business transacted as may be indicated. The conference will be open to all members and guests of the American Public Health Association.

A CONFERENCE on New Developments in Wood Products will be held at the New York State College of Forestry of Syracuse University on October 6 and 7. Dr. William P. Tolley, chancellor of the university, will make the address of welcome. Addresses at the dinner to be held on the evening of October 6 will be given by Dr. Joseph S. Illick, acting dean of the college, whose address is entitled "Looking Ahead in Forest Education" and by George W. Trayer, chief of the Division of Forest Products of the U. S. Forest Service, who will speak on "New Wood Products in Our Future Economy."

AT the third biennial National Chemical Exposition and the National Industrial Chemical Conference that will be held in Chicago in November, there will be a joint luncheon at the Palmer House on November 15, with members of the Chicago Association of Commerce and the Chicago Section of the American Chemical Society taking part. A discussion of "New Research Developments in Industry" will be given by Dr. Roy C. Newton, of Swift and Company; J. K. Roberts, of the Standard Oil Company of Indiana, and Dr. Ernest H. Volwiler, of the Abbott Laboratories.

THE thirty-third National Safety Congress and Exposition will be held at Chicago on October 3, 4 and 5 under the presidency of Colonel John Stilwell, vice-president of the Consolidated Edison Company of New York.

THE New York Academy of Medicine announces the availability of the Louis Livingston Seaman Fund for the furtherance of research in bacteriology and sanitary science. One thousand dollars is available for assignment in 1944. This fund was made possible by the terms of the will of the late Dr. Louis Livingston Seaman, and is administered by a committee of the academy under the following conditions and regulations: (1) The committee will receive applications either from institutions or individuals up to November 1. Communications should be addressed to Dr. Wilson G. Smillie, chairman of the Louis Livingston Seaman Fund, 1300 York Avenue, New York 21, New York. (2) The fund will be expended only in grants in aid for investigation or scholarships for research in bacteriology or sanitary science. Expenditures may be made for the securing of technical help, for aid in publishing original work and for the purchase of necessary books or apparatus.

THE Ordnance Distinguished Service Award has been conferred on the American Society for Metals in recognition of its activities in speeding war production through metals education and training work. The award, a scroll bearing the traditional seal of the Ordnance Department, will be presented during the Metal Congress and War Conference Display at the annual dinner of the society on October 19 at the Hotel Statler, Cleveland. Cooperating with the American Society for Metals will be the American Welding Society and the Iron and Steel Division and the Institute of Metals of the American Institute of Mining and Metallurgical Engineers; the American Industrial X-Ray and Radium Society, and the Society for Experi-

mental Stress Analysis, as well as some three hundred and fifty manufacturers who will participate in the display.

THE Long Island College of Medicine announces its third intensive postgraduate course in industrial medicine to be given at the college from October 16 to November 3. The course will be conducted by leading physicians in industrial practice, authorities in allied fields and members of the faculty of the college. The main objective is to give those physicians engaged in or who may enter industrial medicine the opportunity to orientate themselves more fully to the field. Although arranged primarily for graduate physicians, others interested in industrial health may apply for admission. All inquiries should be addressed to Dr. Thomas D. Dublin, Department of Preventive Medicine and Community Health, 248 Baltic Street, Brooklyn 2, New York.

The British Medical Journal reports that an Academy of Medical Sciences has been founded in the U.S.S.R. The academy, whose members to start with will number fifty-six, is to be set up under the People's Commissariat of Health, and will have three departments: (1) medical biology; (2) hygiene, microbiology and epidemiology; and (3) clinical medicine. Each of these will be composed of several scientific institutes, twenty-five in all, many of which will be, in effect, an extension of the appropriate section of the All-Union Institute of Experimental Medicine which is being merged with the academy. An organizing bureau has been set up under the chairmanship of the People's Commissar for Health of the U.S.S.R.

IT is stated in *Science and Culture,* Calcutta, that the Government of India plans to publish an Indian Pharmacopoeia. It has asked the Drugs Technical Advisory Board to prepare the material for a list of drugs in use in India and to recommend standards and tests with which to establish their uniformity, identity and purity. These drugs, although not included in the British Pharmacopoeia, are said to be of sufficient medicinal value to justify their inclusion in an official pharmacopoeia. The list, when approved, will be known as the Indian Pharmacopoeial List and will constitute the official Indian Supplement to the British Pharmacopoeia. A committee, of which Sir R. N. Chopra is chairman, has been set up to examine the material for the list and report to the board.

DISCUSSION

WAS THERE ICE AT COQUIMBO?

I THINK there was. I can not imagine anything else that could have carried rocks of such dimensions out to sea. Yet they now lie embedded in a coquina of subtropical shells. The rocks suggest a glacial epoch, but the fauna could not have lived in cold waters. The facts are these.

In latitude 30 degrees, south, the town of Coquimbo, Chile, stands upon a rocky ridge between the Pacific and Coquimbo Bay and spreads out on wave-cut terraces. Eastward, across the bay, the land rises steeply in a succession of terraces, cut upon strata of Pliocene and Recent age. It is clear that during Pliocene and Recent time the coast subsided and received deposits of the sediments that consisted in great part of the very abundant shells. The subsidence continued until the fronts of alluvial cones that are now about 475 feet above sea were at sea level. At some date during Recent time the movement was reversed, the land rose, and as it did so the Pacific carved terraces upon the horizontal strata. As the waves cut the terraces they mingled fossils of Pliocene age with shells of the current date and laid a trap for the unwary paleontologist.

The locality is classic ground. Darwin, who examined the terraces with characteristic thoroughness more than a hundred years ago, while the *Beagle* lay in the harbor, noted particularly the evidence of uplift. He described six levels or terraces and concluded that the rise had been a gradual one. He collected fossils, which were described by Sowerby and D'Orbigny as of Pliocene and Recent age. The German geologist, G. Steinman, also collected here and his fossils were studied by W. Möricke with the same result. But in neither case is there any account of the horizons from which the various species came. Darwin alone records that he found shells of species now living in adjacent waters as high as 242 feet above sea. I visited the region in 1923, when following up the tracks of the great earthquake of November 10, 1922, and with a thought of my Tertiary-minded colleagues at Stanford I collected from several levels up to the top of a bluff, 136 feet above sea, and also at Coquimbo from the coquina of a terrace 230 to 250 feet above sea. My collections were examined by my young friend, Eric Jordan, whose tragic death cut short the promise of a brilliant career, and he identified the suite of 31 species as Pliocene throughout. None of them could have lived in waters any colder than the present.

I came upon the big rocks at a somewhat higher level, where the strata may be post-Pliocene, but I was so intrigued by the problem of their transportation that I failed to collect at their horizon. I did not notice any change of fauna, but then, I am not a paleontologist. The rocks are embedded in coquina or lie upon the adjacent slope. The exposed surfaces of one buried one measure more than 6 feet on a side and there is another on the slope that is 23 feet long by 12 feet high. They are of a heavy, black igneous rock, which forms the walls of a little canyon, a quarter of a mile distant. About 30 feet above the horizon of the big rocks is another layer of smaller ones. Two horizons of erratics! In the heights of the Andes, even in this latitude, there are traces of glaciation and farther south there are evidences of two strongly characterized glacial epochs.

Assuming that the parallel of two horizons of erratics and two glaciations is not fortuitous, I have speculated that the rocks do record the presence of ice on the coast during each of the glacial epochs; that the Humboldt current was chilled by the floes of spreading antarctic ice; and that in the latitude of 30°, where cold winds pushed under warmer air currents, there was heavy snowfall; snow accumulated in the shaded canyon in sufficient volume to form ice; and exceptional floods swept ice and rocks out to sea.

If that really was the case, the marine fauna of preglacial and interglacial time must have been killed off; it would, however, survive farther north and would have returned with post-glacial amelioration of conditions. We would expect, however, to find fine sediments and cold-water forms interbedded with the warm water deposits. If that evidence exists, it is obscure. Neither Darwin nor Steinmann detected it. I did not discover it, although I photographed the erratics and puzzled over their distribution. During the rise of the coast soft sediments might be entirely removed as they passed through the zone of that wave action whose power is shown by the strongly marked terraces. The record may have been washed away. Yet there should somewhere survive a pocket of glacial silt. One ought not to be surprised to find a subarctic foram in the cast of a subtropic Venus. A fuller account of my observations is published in "Earthquate Conditions in Chile," Carnegie Institution of Washington, Publication 136, together with Eric Jordan's discussion of the fossils.

BAILEY WILLIS

ISOLATION OF VIOLACEIN

DURING the spring and summer of 1936 the writer worked under the direction of Professor Fritz Kögl at the University of Utrecht, on the nature of the purple pigment elaborated by *Chromobacterium violaceum*. Samples of the crystalline pigment, violacein, were brought to this country by the writer, and have recently been made available to Dr. H. C. Lichstein, of the University of Wisconsin Medical School, who has investigated the toxicity of the pigment to a variety of pathogenic organisms. Since the substance appears to possess considerable antibiotic properties,[1] and since published procedures for its isolation[2] failed to yield a crystalline product,[1] it is considered desirable to make available the details of the isolation procedure used successfully by the writer at Utrecht. It is regrettable that it has not been possible to consult Professor Kögl prior to the publication of this note.

Sixty-five liters of a medium containing 5 g of peptone, 5 g of lactose and 3 g of Liebig's meat extract per liter, was distributed among 460 Erlenmeyer flasks of 750 cc capacity, and the flasks were sterilized by heating in the autoclave at 110° for 30 minutes. After inoculation with a heavily pigmented culture of the organism, the flasks were incubated at 22° for 14 days, and the cells then collected by centrifuging. The moist, purple bacterial mass (151 g) was rubbed up with 3 liters of acetone, transferred to a large bottle, and mechanically agitated for 30 minutes. The mixture was filtered with suction, and the cells were re-extracted as before with 1.5 liters of acetone. The combined acetone extracts were concentrated at reduced pressure from a 60° water bath to ca. 200 cc, allowed to stand at 5° overnight, and filtered. The nearly black, partly crystalline powder obtained was dried at 90° *in vacuo* over P_2O_5, and then weighed 906 mg.

The crude violacein prepared as above was placed in a Soxhlet apparatus and extracted for one hour with dry chloroform, and then for an additional hour with dry ether. The unextracted material remaining in the thimble was dissolved in 240 cc of boiling pyridine, filtered, the filtrate concentrated to ca. 150 cc and the hot solution diluted with 50 cc of boiling chloroform. The mixture was allowed to cool, and was then placed at 4° for several hours. The pigment was filtered with suction, washed with chloroform-pyridine (1:1), and with chloroform, and dried at 90° *in vacuo* over P_2O_5 for 2 to 3 hours. There was obtained 710 mg of pure violacein as a violet-black, micro-crystalline powder, consisting of thick needles and elongated rectangular crystals. The substance does not melt without decomposition.

F. M. STRONG

DEPARTMENT OF BIOCHEMISTRY,
UNIVERSITY OF WISCONSIN

[1] H. C. Lichstein and V. vandeSand, *Jour. Infect. Dis.* (in press).
[2] W. C. Tobie, *Jour. Bact.*, 29: 223, 1935.

TEN O'CLOCK MARKS[1]

SOME fifteen years ago while engaged in the reconnaissance survey of western Texas and southeastern New Mexico leading to a search for suitable potash core-drill sites, the writer while examining the terrain became conscious of a faint linear arrangement of patches of light sandy-loam soil which appeared on clear winter mornings following a frosty night. The peculiar lumpy condition of the soil was plainly due to frost action, but the origin of the faint-grained pattern superimposed upon this matte of raised soil was less certain.

The pattern once noticed is easily recognized elsewhere. It appears as a series of parallel straight lines as if the surface had been raked into small ridges and furrows about an inch or more from crest to crest and three-eighths to three-quarter inch deep. Wherever these striated surfaces were seen, the lines always pointed in a southeasterly direction which accords with the position of the sun at about ten o'clock on a winter morning in the vicinity of latitude North 30°. This suggested that some action of the sun was the cause of the pattern and as it had been seen always on ground sparsely covered by small bunch and buffalo grass, it was assumed the long, low-angle shadows cast by the grass had caused the differential melting of the frost in the soil. Consequently the subject was dismissed as of little importance until one day a year or two later I chanced to see a wide spread of frost-lifted loam with well-developed striae out in the middle of a broad playa, far removed from anything that could possibly cast a shadow. All the striae were oriented in line with the position of the sun in mid-morning. It was plain that two events had occurred between nightfall and late morning to change a previously smooth sandy-loam surface into this roughened and striated condition. Patches of ground containing a proper amount of moisture had frozen during the night raising lumps of soil above the level of the flat and in the morning the warmth of the sun in drawing the frost had caused a differential collapse of the raised material. The thawing and collapse on an exposed surface occurs at a critical moment and all within a few minutes of time. To one's imagination it appears as if streams of quanta had bombarded the supports from beneath rows of pedestalled soil but left other rows untouched.

Where moisture is supplied from beneath the surface and not from the atmosphere during a night of freezing temperature, frost-lift of soil is a common occurrence. It is most conspicuous in the southeastern states where saturated sandy soils oozing water during a night of freezing temperature grow carpets of slim, columnar, ice crystals which carry up with them the overlying surface material. When the ice on a level surface melts, the soil and debris fall back into place without giving suggestion of a regular or linear pattern. On a sloping surface the material drops down grade, thus serving the process of soil creep.

One winter, some years later, I came upon a smooth northwesterly-facing embankment with a four-foot radius of curvature. It was covered with frost-striae, but the lines did not have a constant direction. It was evident that this surface became progressively exposed to the sun from the upper to the lower part of the slope and that during this period of advancing exposure, the sun had moved through a wide arc to the west. Thus tangents to the curved striae were found to point in the direction of the sun at the time of initial exposure. This example gives further emphasis to the strange relation that the sun's rays have to these striae.

In all previous cases the effect was produced by the morning sun that by about ten o'clock on a winter day had warmed the air and the ground sufficiently to melt the frost. Those seen on the curved surface were formed in the afternoon. To produce and preserve these striae required an evenly balanced temperature throughout the day, one in which the air near the ground remained slightly below freezing in the shade but was raised slightly above freezing in the direct rays of the sun. The pattern progressively developed as the frozen surface emerged from the shadow.

This spring I happened to see straight striae on snow in Washington. The surface was dirty, but no relation existed between the arrangement of the dirt and the course of the striae. Their trend was also toward the position of the late morning sun. Foreign material, especially dark rock fragments, often make conical holes in ice and snow which point to the sun, but there seem to be few parallel examples of ablation effects[2] to serve as an explanation as to how these ten o'clock marks are formed. That these striae are repetitional realities is certain, for they have served the writer as a compass on overcast days, when the marks will persist a day or two under favorable conditions. The solution of the problem of their origin requires more detailed observation than it was possible for the writer to give to them in the fulfilment of his other duties.

WALTER B. LANG

[1] Published by permission of the Director, Geological Survey, U. S. Department of the Interior.

THE DEANE COLLECTION OF PORTRAITS OF ORNITHOLOGISTS—THE DEVELOPMENT OF AN IDEA

RUTHVEN DEANE was a retired business man of

[2] C. K. Wentworth, *Am. Jour. Science*, 238: 2, 112–116, February, 1940.

Chicago, a founder, fellow and one of the best-known early members of the American Ornithologists' Union. He was essentially a social individual, made friends readily and retained them indefinitely, a tireless letter writer, anxious to meet his correspondents and inquisitive as to their activities. It was not enough for him to know his confrères, their ornithological proclivities and accomplishments, he wanted to know how they looked. As a hobby he began collecting photographs of bird men—likenesses he called them—of ornithologists he had met, with whom he had corresponded or of whom he had heard. His album included photographs large and small, wood cuts, lithographs, half tones and steel engravings, in fact, any form of portrait reproduction. In order to keep his collection within reasonable bounds and at the same time have a goal, he limited his activities chiefly to the more permanent membership of the American Ornithologists' Union, including the fellows, foreign fellows and full members. Each "likeness" was carefully labeled, entered in a catalogue and filed away where it could be consulted when wanted.

This collection was modeled after another brought together by Dr. Paul Leverkuhn of Sofia, Bulgaria, librarian and private secretary of H. R. H. Prince Ferdinand. After the death of Dr. Leverkuhn his collection, then the largest of its kind in the world, was sold and dispersed. As shown by a list published in the *Proceedings of the World Congress of Ornithology* in 1896, it contained 387 subjects and a total of 515 items.

Deane, after working on his hobby for nearly half a century, found that his collection was growing rather unwieldy for the limited space available in his apartment and began to make plans for its future care and development. Several libraries were anxious to acquire it, but he insisted that it must be fully indexed so as to identify and "bring out" each individual represented. With this condition attached, the largest libraries in Chicago, Boston, New York and Washington hesitated to accept it even as a gift. Finally after correspondence extending over a period of eight years, the Library of Congress found a way to comply with the conditions, and in January, 1934, two months before his death, Deane's collection was delivered to the Library of Congress.

On arrival it was placed in the Division of Fine Arts, immediately accessioned and found to contain about 1,000 subjects, or nearly two and a half times as many as were represented in the Leverkuhn collection. Each portrait was given a number and placed in a standard sized envelope on which was marked the full name of the individual and the years of his birth and death. The envelopes were then filed in vertical steel cases and the large portraits and steel engravings placed in suitable portfolios. A special index card was prepared with spaces for full name, date and place of birth, date and place of death, position, title of one or more publications and reference to a published biography, if any, degrees and any miscellaneous information. From five to eight items were called for on each card requiring in a collection of 1,000 individuals from 5,000 to 8,000 items of information.

Ten years have passed since the Deane collection was transferred to the Library of Congress and transformed from a private collection to an integral part of a great national collection of portraits. During these years several notable contributions have been received, but these contributions have added to the series of photographs rather than to the number of individuals. The American Ornithologists' Union has elected a number of new fellows and members. Some of the old members have died, many new biographical sketches have been published and much biographical data formerly inaccessible are now available. All these changes require additions to the index cards. Comparison of the index with the recent membership lists of the Union indicate that about 200 photographs are now needed to bring the collection up to date.

Examination of the list of the former Leverkuhn collection shows that about 335 portraits in that collection are not represented in the Deane collection. As most of the portraits in the former collection were published, it is possible to obtain copies of them provided the place of publication can be found. Many of these have been located in the hope of obtaining copies and thus practically restoring the Leverkuhn collection, dispersed nearly forty years ago.

Bearing in mind the fact that the nucleus of the Deane collection was based on part of the membership of the American Ornithologists' Union, the expansion of the collection in conformity with its present national character is being planned in certain directions but still within the limits of the activities of the Union. The first step proposed is to include portraits of persons who have described birds, or in whose honor birds have been named, in the *Check List of North American Birds*. This should require the addition of perhaps 200 more names. Another step is to develop a feature which Deane had in mind but in which he had made only a beginning—namely, to bring out the background of ornithological work by including views showing the homes where ornithologists lived, the museums where they worked and where collections of birds are preserved, the more notable localities where collections were made and the leaders of expeditions on which ornithological specimens were collected.

The Deane collection is only one of a number of similar collections of portraits of scientific men which

exist in various parts of the country. The Brasch collection of 2,000 mathematicians and astronomers now in the library of Stanford University, the Howard collection of 3,000 entomologists in the Bureau of Entomology in the U. S. Department of Agriculture, the National Museum collection of some 10,000 prominent men and a similar collection of some 50,000 portraits in the library of the Wisconsin Historical Society at Madison give some idea of the character and scope of a few of these collections. But the Deane collection differs from all the others in several notable respects. The Howard collection is accompanied by a card index of names but without further data. The National Museum series is provided with a typewritten list of names also without further data. Each of these collections may contain two or three pictures of an individual, whereas the Deane collection has 15 to 18 of some men. Finally, the accompanying index card shows at a glance the essential facts regarding each individual—his age, birthplace, position, publications and a reference to his biography.

A similar collection in a university or historical library in each state, based on the activities of local workers, would make available a vast amount of information concerning the progress of science and industry that is now more or less inaccessible.

Ruthven Deane builded better than he realized. His desire to know what his confrères looked like developed into a hobby. His desire to know something about each individual developed into the museum concept of making a portrait illustrate a label or index card, and finally his long search for a suitable depository for his life work resulted in the development of his hobby into a national collection, a model of its kind, devoted to the diffusion of knowledge and accessible to all who may be interested in it.

T. S. PALMER

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SCIENTIFIC BOOKS

ALLERGY

Allergy, Anaphylaxis, and Immunotherapy. By BRET RATNER, M.D. Baltimore: Williams and Wilkins Co., 1943. 864 pp. $8.50.

THIS book has a misleading title. Knowing that Ratner has long been concerned with problems of allergy, the reader will be considerably surprised that the index does not mention ragweed, or pollen, or even hayfever. The subtitle is more clearly descriptive: "A treatise presenting the fundamental principles and practice governing the use of antisera, vaccines, toxoids, blood transfusions, blood substitutes and sulfonamides, in the prevention and treatment of infectious diseases and of the allergic phenomena resulting from their use."

As the author frankly intimates in his prefatory remarks the book really represents "The Education of Bret Ratner" acquired as a preliminary to the writing of a text on allergy in childhood. It appears to me that the projected volume will probably be more unified than the present one, which is essentially made up of three books bound together.

I. *Principles and practice of immunotherapy:* 157 pages dealing with the nature and preparation of various materials used in the diagnosis, prevention, and treatment of infectious diseases (including 50 pages on the sulfonamides); 218 pages on the application of these materials to the control of about 40 diseases. The chapter-headings in this section are arranged alphabetically, which results in some strange and illogical bedfellows—xix, Meningitis, Mumps, Plague. xxv. Scarlet Fever, Syphilis.

This Book I is distinctly inferior to the remainder of the volume. It is a rather tiresome compilation of the author's readings rather than his doings and is burdened with trivial and irrelevant details—"wearing of heavy leather puttees . . . gauntlets . . . tourniquets"—for the prevention and treatment of snakebite, are recommendations that seem out of place in a book of this kind.

Books II and III, *Allergy to Immunotherapeutic Agents* (sera, blood, drugs) and *The Allergic State* (physiological pathology, blood changes, mechanism) reflect Ratner's experience and critical thinking. The presentation, therefore, is much more effective than in Book I. The discussion of allergy to serum is particularly extensive and detailed; it should be carefully examined by all students of the subject although many readers will have some dissenting opinion. Had this section, perhaps with some expansion, been presented as a monograph the contribution to medical literature would have been more clear-cut than is the book as a whole.

The full bibliography (55 pages) is a valuable feature, especially because it is arranged alphabetically by authors' names. As are many others, the reviewer is exasperated by the footnote-style of citation with its repetitious and virtually useless *loc. cits* and *ibids.*

The index, however, merits little praise. There are many examples of such entries as "Diphtheria, prophylaxis. *See* active immunization." "Diphtheria, Schick test. *See* Schick test." "Dog anaphylaxis. *See* Canine anaphylaxis." "Electrocardiographic changes. *See* under Allergy." Most cross-references

of this kind are quite unnecessary. They waste space as well as the reader's time and patience. If their inclusion is considered desirable the page-numbers should accompany them so that backward or forward search for an informative entry may be avoided. The tedious preparation of an index is frequently left to the publishers. Authors should take more responsibility for this useful part of their books.

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QUANTITATIVE ANALYSIS

Introduction to Quantitative Analysis. By SAUL B. ARENSON and GEORGE RIEVESCHL. New York: Thomas Y. Crowell Company. 1944. $2.75.

EVERY one has known the obstreperous sort of person who always manages a resounding back-slap and pumping right hand by way of greeting. This book is written in the style of such an over-friendly fellow. The second person is used, you, the reader or student, being addressed throughout the book. The analogies used are very homely: tea mixing, the distance and rate of travel between Akron and Cincinnati and similar examples are used to solve problems. Such analogies seem inconsistent with the chapters on electrochemical and neutralization theory, students capable of mastering the latter very probably being insulted by the former. Some of the many procedures listed probably are of doubtful value to the elementary student. For example, the determination of moisture in butter, alcohol in a beverage, free fatty acid in fats and oils, Al $(OH)_3$ in a medicinal preparation, vitamin C in vegetables and four volumetric methods for sulfate are listed. In all fairness, it should be stated that a sufficient number of other procedures are included, placing the above-mentioned experiments in the "optional" category.

On the positive side, the book seems to be a serious attempt to step out away from the stogy, time-honored and, in many cases, dull procedures to be found in the ordinary text on quantitative analysis. It is to be hoped that this book exerts an influence in such a direction on the field as a whole. An excellent series of problems is included, the book is well documented, and the variety of procedures exceeds any other book of comparable scope.

The physical make-up of the book follows war-time standards. Typographical errors are relatively few, but rather crucial. For example, the student is advised to take 25 ml of 3 per cent. H_2O_2 for N/10 permanganate titration, and 0.25 M "ferroin" is recommended as indicator for ceric sulfate titrations.

Quantitative Inorganic Analysis. By I. M. KOLTHOFF and E. B. SANDELL. Revised edition. New York: Macmillan Company. 1943. $4.50.

THIS revision of a well-known book brings it up to the times, the chapters on organic reagents, spectrophotometry, errors and precipitation phenomena being augmented and brought in line with the latest work in the field. A section on amperometric titrations has been added.

For a book with as wide a scope as this one, it seems regrettable that no mention is made of some of the modern theories of acid-base phenomena or of the fallacies inherent in ionic equations. It would seem to be less misleading to use molecular equations, obviously fallacious, than to use ionic equations containing, for example, Ti^{+4}, Fe^{+3}, Cr^{+3}, etc., which give an impression of correctness.

Many instructors will find the book too all-inclusive for a general elementary course, although it should be excellent when used as an elementary book for chemistry majors.

The physical make-up of the book is exceptionally attractive, being scarcely different from the pre-war product.

In general, the book is by far the best link between elementary and advanced quantitative analysis yet produced.

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REPORTS

ARCTIC INSTITUTE OF NORTH AMERICA

A MEETING of Canadians and Americans interested in scientific research into Arctic problems met in Montreal on September 8 and completed plans for the early establishment of an Arctic Institute of North America, first reported in SCIENCE[1] in May of this year. The project was initiated at a similar meeting held in New York on May 13.

[1] SCIENCE, 99: 2578, 423, May 26, 1944.

The thinking of the organizing group has been broadly as follows:

Wide interest in the Arctic is being expressed at present in both Canada and the United States and a strong scientific and developmental movement in Arctic North America is expected to begin as soon as the war is over.

Despite the excellent reconnaissance studies accomplished by a number of exploring expeditions,

our detailed scientific knowledge of Arctic North America is comparatively slight. As a result the natural resources of Alaska, Arctic Canada and Greenland are far from completely developed, and full advantage has not been taken of the possibilities for living in that region.

The situation in the far northern part of this continent to-day is analogous in some respects to the situation in the undeveloped West in the middle of the last century. Many basic questions about the West were answered by the reports of scientifically organized surveys and by private exploration undertaken at that time in response to a widespread demand.

Questions of basic importance in a number of scientific fields can be solved only through studies undertaken in the Far North. Furthermore, carefully chosen scientific study can furnish a sound basis for the thoughtful planning upon which the development of North America's last frontier, the welfare of the people who live there now and the larger number of people who may be expected to live there in the future, should be built. A new, extended and independent program of scientific study of the North American Arctic therefore will not only contribute in a large way to the advancement of scientific knowledge, but will also constitute a broad public service of immediate practical significance.

The organizing group believes that such a study should be integrated with studies already under way and should be systematically designed to answer the major questions that must be answered before intelligent and orderly development of the Far North can be undertaken. It would necessarily involve:

(a) General research into the natural conditions of the North.

(b) Studies applied to specific problems of the development of the Arctic and of Arctic living.

(c) A broad study of the relationships of the Arctic regions to the physical, social and economic problems of the world as a whole.

It is intended that the scope of activities of the institute will include the collection and diffusion of information relating to the Arctic and Subarctic regions of North America. The work will be exclusively scientific. Fields of pure and applied research may include geologic studies; physical and chemical studies relating to geophysics, oceanography and meteorology including ionospheric and related phenomena; broad biological studies including animal and timber resources; social studies of the region including the history of early man in North America; agricultural possibilities; navigation, transport and communication; public health.

A constitution and tentative budget have been adopted. It is expected that the institute's personnel will consist of a small, full-time administrative staff headed by a director. An international group of men, many of them scientists, elected on a rotating basis for specific terms, will meet periodically with the full-time staff to consider specific research projects and to advise on the distribution and coordination of research effort. It is hoped that sufficient funds will be available to make, each year, a considerable number of research grants to qualified scientists irrespective of their principal professional affiliations.

The institute will be clearly North American, international in character and common to Canada, the United States, Newfoundland and Greenland. Within the North American Arctic the boundary between Alaska and Canada is entirely artificial, while that between Canada and Greenland is hardly less so as far as Arctic research is concerned. The basic scientific questions to be answered are common to the entire Arctic region. Accordingly, great economy of effort, avoidance of duplication of investigations and wider common discussion of problems would be secured by treating the North American Arctic as a region to be studied as a unit—the study to be for the common good of the people and states concerned. Such a unit treatment, if properly organized and administered, should have the further advantage of contributing largely to international good-will through a new kind of direct international cooperation.

It is expected that the offices of the institute will be established in Canada, probably in Montreal.

Funds for organizational expenses, pending the establishment of the institute as a research organization, have been generously contributed jointly by the National Research Councils of the United States and Canada.

The following persons were present at the recent organizational meeting:

Dr. A. Bajkov, Army Air Forces Personal Equipment Laboratory, Wright Field, Ohio.

Dr. E. G. Bill, Dartmouth College, Hanover, N. H.

Dr. S. W. Boggs, Chief, Division of Geography and Cartography, Department of State, Washington.

Dr. R. W. Boyle, National Research Council of Canada, Ottawa.

Dr. C. Camsell, Deputy Minister of Mines and Resources, Ottawa.

Dr. H. B. Collins, Ethnogeographic Board, Smithsonian Institution, Washington.

Dr. H. J. Deason, special assistant to the director of the Fish and Wildlife Service, Department of the Interior, Washington.

Major R. F. Flint, National Research Council of the United States; Arctic, Desert and Tropic Information Center, Army Air Forces, New York.

Dr. L. M. Gould, National Research Council of the United States; Chief of the Arctic Section, Arctic, Desert and Tropic Information Center, Army Air Forces, New York.

Group Captain W. F. Hanna, Department of National Defence for Air, Ottawa.

Dr. D. Jenness, Department of Mines and Resources, Ottawa.

Dr. H. L. Keenleyside, Department of External Affairs, Ottawa.

Dr. T. Lloyd, Department of Geography, Dartmouth College, Hanover, N. H.

Commander D. B. MacMillan, USN. Hydrographic Office, Washington.

Dr. R. Newton, President of the University of Alberta, Edmonton.

Dr. J. J. O'Neill, Department of Geological Sciences, McGill University, Montreal.

G. R. Parkin, Sun Life Assurance Company of Canada, Ltd., Montreal.

Commander G. A. Patterson, USN. Hydrographic Office, Washington.

Dr. V. Stefansson, 67 Morton Street, New York.

Lt. A. L. Washburn, Arctic Section, Arctic, Desert and Tropic Information Center, Army Air Forces, New York.

Ensign J. C. Weaver, USNR, Hydrographic Office, Washington.

Col. J. T. Wilson, Director of Operational Research, National Defence Headquarters, Ottawa.

Dr. V. C. Wynne-Edwards, Department of Zoology, McGill University, Montreal.

Until further announcement, communications should be addressed to L. M. Gould, Carleton College, Northfield, Minnesota.

RICHARD FOSTER FLINT

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(*On leave of absence*)

SPECIAL ARTICLES

IMPAIRMENT OF RESPONSE TO STILBESTROL IN THE OVIDUCT OF CHICKS DEFICIENT IN L. CASEI FACTOR[1] ("FOLIC ACID")

SEVERAL experimental and clinical studies have indicated a close relationship between the metabolism of the estrogens and the vitamins of the B-complex.[2,3,4,5] Stilbestrol[6] normally induces a marked proliferation of the tissues of the genital tract. This is reflected in an increase in weight of the genital organs which may be employed as an index of stilbestrol activity.

We have found that large doses of stilbestrol elicit only a slight weight increase in the oviducts of chicks maintained on a diet deficient in *L. casei factor* (L.C.F.). However, a marked weight increase is observed in the oviducts of control chicks receiving L.C.F. supplements either curatively or prophylactically. Moreover, pantothenic acid deficient chicks show substantial oviduct responses to stilbestrol.

New Hampshire Red chicks were maintained from hatching on the purified diet and supplement described by Campbell *et al.*[7] L.C.F. was administered by dropper either as the aqueous solution of crystalline material or as a concentrate. All estrogen-treated chicks received 0.5 mgm of stilbestrol in 0.1 cc of corn oil subcutaneously on each of the six days preceding autopsy.

The data (Table 1) show a striking difference between the oviduct weights obtained after stilbestrol administration in the L.C.F.-deficient chicks and in

TABLE 1

OVIDUCT WEIGHT RESPONSE TO STILBESTROL IN L.C.F. AND PANTOTHENIC ACID DEFICIENT CHICKS.*

	No. of Chicks	Oviduct mgms mean	Oviduct mgms range	Body wt. gms mean	Body wt. gms range
20 γ cryst. L.C.F. daily from birth	9	450	309–777	140	111–166
20 γ cryst. L.C.F. daily last 10 days	12	196	84–474	110	59–158
No L.C.F.	16	62	32–82	71	53–90
10 γ eq. L.C.F. conc. daily from birth	15	462	200–666	125	108–158
10 γ eq. L.C.F. conc. daily last 10 days	14	184	90–457	107	69–170
No Pantothenic; 10 γ eq. L.C.F. conc. daily from birth	9	281	156–553	70	60–80

* All chicks 21 to 25 days old at autopsy; oviduct weights of 13 uninjected chicks of the same age averaged 25 mgms (range 19–33) and their body weights averaged 117 gms (range 97–144 gms).

[1] The term "*L. Casei Factor* (L.C.F.)" refers to that member of the "folic acid" group isolated by B. C. Hutchings, E. L. R. Stokstad, N. Bohonos and N. H. Slobodkin (SCIENCE, 99: 371, 1944) and found by them to be active in the nutrition of the chick. This material was kindly furnished by Lederle Laboratories through the courtesy of Dr. E. L. R. Stokstad.

[2] M. S. Biskind and M. C. Shelesnyak, *Endocrinology*, 30: 819, 1942.

[3] M. S. Biskind, G. R. Biskind and L. H. Biskind, *Surg., Gynec. and Obst.*, 78: 49, 1944.

[4] A. Segaloff and A. Segaloff, *Endocrinology*, 34: 346, 1944.

[5] H. O. Singher, C. J. Kensler, H. C. Taylor, Jr., C. P. Rhoads and K. Unna, *Jour. Biol. Chem.*, 154: 79, 1944.

[6] E. C. Dodds, L. Goldberg, W. Lawson and R. Robinson, *Nature*, 141: 247, 1938.

[7] C. J. Campbell, R. A. Brown and A. D. Emmett, *Jour. Biol. Chem.*, 152: 483, 1944.

the supplemented controls. This difference obtains whether the L.C.F. supplement is administered from hatching or only as a curative measure during the last ten days preceding autopsy.

In the curative experiments there was considerable variability in the degree of therapeutic effect as evidenced by increase in body weight. The stilbestrol response varied accordingly, thus reducing the mean oviduct weight for the group as a whole. Nevertheless, the restorative effect of the administered L.C.F. on the oviduct response is apparent.

The pantothenic acid deficient chicks showed a growth failure quite comparable to that observed in the L.C.F. deficient animals. Despite this marked effect, they exhibited a good response to stilbestrol, indicating that debility and limitation of growth are not sufficient, *per se*, to effect the reduction in oviduct response observed in the L.C.F.-deficient chicks.

The normal response to stilbestrol stimulation is characterized by a substantial increase in the thickness of the muscular and mucosal layers of the oviduct. Gross examination of the oviduct of the stilbestrol treated L.C.F.-deficient chick reveals that the small weight increase over the normal may be attributed to accumulation of fluid in the lumen and that the walls of the oviduct remain thin and translucent.

The data indicate that an adequate intake of *L. casei* factor is essential for the normal metabolism of stilbestrol in the chick. This finding is an interesting example of the interdependence of a dietary trace substance and a hormone-like factor and further emphasizes the importance of adequate nutrition for normal endocrine function.

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INHIBITION OF METAL CATALYSIS AS A FUNGISTATIC MECHANISM

MECHANISMS of action for chemicals that inhibit growth of or are lethal to microorganisms are little understood. Knowledge of positional effects of various atomic groupings is extensive, and general mechanisms are frequently cited, including protein precipitation, enzyme inactivation, inhibition of respiration. However, specific cases are rare for which the *modus operandi* of inhibitory or lethal action is known. Possible exceptions are the sulfonamide antagonism,[1, 2] the blocking of enzyme surfaces by adsorption of heavy metals to the active areas,[3] and the inhibition of the -SH group by $HgCl_2$.[4]

The fact that microorganisms require traces of several metal elements indicates that these elements are involved in catalytic processes in the cells; *i.e.*, that the metals function as part of one or more enzyme systems.[5] Hence a chemical capable of precipitating the metals in such enzyme systems should prevent growth of microorganisms by inhibiting metal catalysis, particularly if metals are precipitated in the form of chelate inner complex salts which are non-electrolytes. 8-hydroxyquinoline forms such chelate salts with many metals,[6] and is also an efficient fungistatic and bacteriostatic compound.[7, 8] It is suggested that the latter property is the result of the former. This theory for the mechanism of fungistatic action of 8-hydroxyquinoline was tested biologically in the following ways:

(1) At lower pH values (in general, below pH 3.5) complex formation does not take place between 8-hydroxyquinoline and certain metals,[9, 10] including several considered essential for growth of fungi: copper, manganese, iron and zinc. Hence the chemical should not be fungistatic at lower pH values as essential metal ions should be available. Flasks of Tochinai nutrient solution (1.5 g. KH_2PO_4, 0.5 g. $MgSO_4$, 10 g. Bacto Peptone, 20 g. C.P. Maltose, 1,000 ml distilled water), in pH series, were inoculated with three test fungi (*Fusarium oxysporum* f. *lycopersici*, *Ceratostomella ulmi* and *Penicillium* sp.). Normal growth was found to occur at low pH values in the presence of as much as 100 mg of 8-hydroxyquinoline per liter (Table 1), a dose far in excess of that causing complete inhibition at higher pH levels.

TABLE 1

EFFECT OF pH ON FUNGISTATIC ACTION OF 8-HYDROXYQUINOLINE

	Average weight (mg) of Penicillium mat at pH:					
	2.2	2.5	3.2	3.8	4.5	5.7
Nutrient plus 100 mg of 8-hydroxyquinoline per liter	378	260	111	0	0	0
Nutrient alone	390	401	347	352	311	184

The effect of increasing acidity is not merely to neutralize the weak basic properties of 8-hydroxyquinoline. Neither is the compound destroyed at low pH values.

[1] D. D. Woods, *Brit. Jour. Exp. Path.*, 21: 74, 1940.
[2] H.McIlwain, *Brit. Jour. Exp. Path.*, 22: 148, 1941.
[3] R. S. Gortner, "Outlines of Biochemistry," Wiley and Sons, 1938.
[4] P. Fildes, *Brit. Jour. Exp. Path.*, 21: 67, 1940.
[5] D. E. Green, *Advances in Enzymology*, 1: 177, 1941.
[6] J. H. Yoe and L. A. Sarver, "Organic Analytical Reagents," Wiley and Sons, 1941.
[7] N. E. Rigler and G. A. Greathouse, *Ind. Eng. Chem. (Ind. Ed.)*, 33: 693, 1941.
[8] G. A. Zentmyer and J. G. Horsfall, *Phytopath.*, 33: 16, 1943.
[9] H. V. Moyer and W. J. Remington, *Ind. Eng. Chem. (Anal. Ed.)*, 10: 212, 1938.
[10] H. R. Fleck and A. M. Ward, *Analyst*, 58: 388, 1933.

(2) Zinc was found to be the most important essential trace element for the vascular pathogens (*F. oxysporum lycopersici, C. ulmi*) used in these tests. Hence, if 8-hydroxyquinoline prevents growth by removing zinc from solution, growth should be resumed when the system is saturated by supplying additional zinc. This was found to be the case. Addition of 25 mg of zinc per liter permitted nearly normal growth of the fungus in the presence of 40 mg of the fungicide per liter. (Table 2.)

TABLE 2

SATURATION OF 8-HYDROXYQUINOLINE SYSTEM WITH ZINC

Mgs. of zinc per liter	Milli-mols 8-hydroxyquinoline per liter	Milli-mols metals added per liter purified nutrient	Calculated molar ratio metal/fungicide*	Dry wt. of fungus mat (mgs)
1	0.2758	.00789	.028	0
5	0.2758	.0848	.308	74
25	0.2758	.3925	1.43	160
1	0	.00789	∞	206.5

*Subsequent chemical analysis showed the presence of metal contaminants in the "purified" nutrient solution, so that these ratios are below actual values.

(3) Increasing amounts of the fungicide should be required to inhibit growth of *Fusarium* in the presence of increasing amounts of zinc. In the presence of 0.5 mg of zinc per liter of nutrient solution, 30 mg of 8-hydroxyquinoline per liter inhibited growth of the fungus. With 5 mg of zinc per liter, 60 mg of the fungicide prevented growth; 30 mg did not.

The above evidence strongly supports the view that 8-hydroxyquinoline owes its fungistatic action to the phenomenon of forming inner complex salts with metal ions and thus rendering them unavailable to microorganisms. A chemical with this type of mechanism of action would obviously be fungistatic rather than fungicidal. The importance of traces of zinc in the metabolism of the vascular fungi indicates that a zinc-protein enzyme may be involved; zinc may be the prosthetic group. Further support for the theory that this fungicide affects metal-enzyme systems is seen in the fact that it inactivates copper-enzyme systems in *Chlorella* and in extracts of higher plants.[11, 12]

The possibility is evident that other known fungicides may be effective because of a similar precipitation of metals essential to fungi. Conversely, analytical reagents other than 8-hydroxyquinoline should be found to be good fungicides. As an example of the latter, ammonium nitrosophenyl hydroxylamine ("Cupferron"), a well-known organic reagent, also forming chelate inner complex salts with metals, has been tested in this laboratory recently and found to have considerable fungistatic value.

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THE ULTRAVIOLET ABSORPTION OF VITAMIN B_c AND XANTHOPTERIN

IN the course of the isolation of crystalline vitamin B_c[1] from liver, we observed that concentrates containing 5 to 10 per cent. of the compound exhibited specific absorption in the ultraviolet region. This property, which proved to be characteristic of the vitamin, was used along with biological criteria in the isolation work. It was apparent from the study of even grossly impure preparations that the intensity and position of the absorption bands were dependent on the hydrogen-ion concentration.

The absorption curves of pure vitamin B_c at four selected pH levels are shown in Fig. 1. Analytical

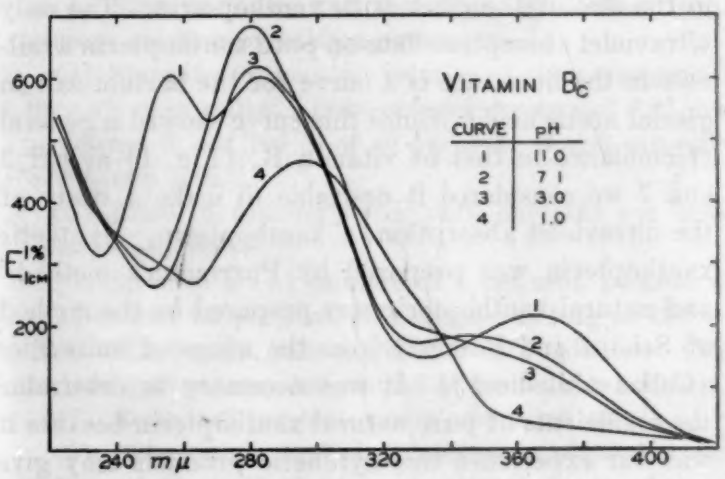

FIG. 1

ash-free specimens isolated from liver and from yeast exhibit identical absorption characteristics.

Stokstad[2] reported the preparation of a *Lactobacillus casei* ε growth factor in purified form from liver and expressed the view that his substance was identical with the previously isolated crystalline vitamin B_c. The shape of the ultraviolet absorption curves which he recorded for his preparation at several pH levels support his view that he was dealing with vitamin B_c, but a comparison of the extinction coefficients with those of the pure vitamin indicate that his preparation was approximately 70 per cent. pure. Mitchell[3] has recently recorded ultraviolet absorption data on "folic acid" concentrates from spinach. We have tried to compare his data with those in Fig. 1. However,

[11] L. F. Green, *et al.*, *Jour. Biol. Chem.*, 128: 447, 1939.
[12] E. Stotz, *et al.*, *Jour. Biol. Chem.*, 119: 511, 1937.

[1] J. J. Pfiffner, S. B. Binkley, E. S. Bloom, R. A. Brown, O. D. Bird, A. D. Emmett, A. G. Hogan and B. L. O'Dell, SCIENCE, 97: 404, 1943.
[2] E. L. R. Stokstad, *Jour. Biol. Chem.*, 149: 573, 1943.
[3] H. K. Mitchell, *Jour. Am. Chem. Soc.*, 66: 274, 1944.

since the pH value of his recorded curve was not indicated and the absorption intensities of his concentrates were low, we were unable to draw any inferences as to the possible identity of the "folic acid" factor and vitamin B_c.

The ultraviolet absorption characteristics of vitamin B_c, coupled with the nitrogen content of the compound[1] suggest the presence in the molecule of a pyrimidopyrazine ring structure (*e.g.*, flavins, alloxazines, pterins). In this connection it is of interest that the pterins have had a long though somewhat uncertain association with nutritional anemia. Their possible role in hematopoiesis was emphasized some time ago by Sir Frederick Gowland Hopkins.[4] In 1936 Tschesche and Wolf[5] reported that the pterins and particularly xanthopterin had hematopoietic activity when administered to rats rendered anemic on a goat's milk diet. More recently Simmons and Norris[6] reported that xanthopterin causes a hematopoietic response in fingerling salmon. On the other hand, O'Dell and Hogan[7] were unable to replace vitamin B_c in the diet of the chick with xanthopterin. The only ultraviolet absorption data on pure xanthopterin available in the literature is a curve for the barium salt in glacial acetic acid.[8] Since this curve showed a general resemblance to that of vitamin B_c (Fig. 1) at pH 3 and 7 we considered it desirable to make a study of the ultraviolet absorption of xanthopterin. Synthetic xanthopterin was prepared by Purrmann's method,[9] and natural xanthopterin was prepared by the method of Schöpf and Becker[10] from the wings of butterflies (Colias philodice).[11] It was necessary to determine the coefficients of pure natural xanthopterin because it was our experience that synthetic products may give acceptable analytical figures and yet be grossly impure. Xanthopterin has no melting point and little crystallization tendency. Identical curves were obtained with analytical ash-free specimens of the synthetic and natural products. In Fig. 2 are recorded the data obtained at approximately the same pH levels as reported for vitamin B_c (Fig. 1).

A comparison of the curves for the two compounds at the different pH levels brings out some very striking dissimilarities, although in general the ultraviolet

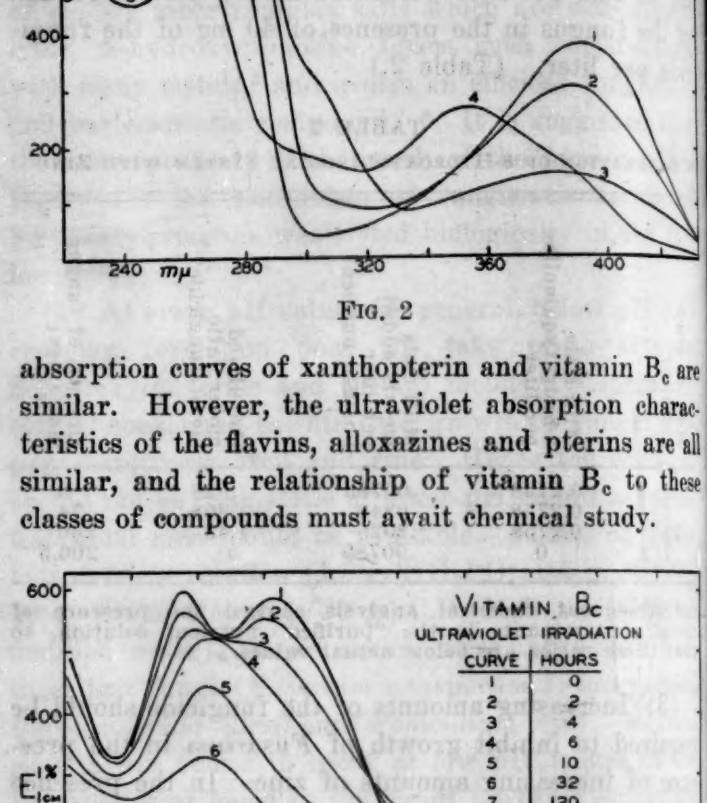

FIG. 2

absorption curves of xanthopterin and vitamin B_c are similar. However, the ultraviolet absorption characteristics of the flavins, alloxazines and pterins are all similar, and the relationship of vitamin B_c to these classes of compounds must await chemical study.

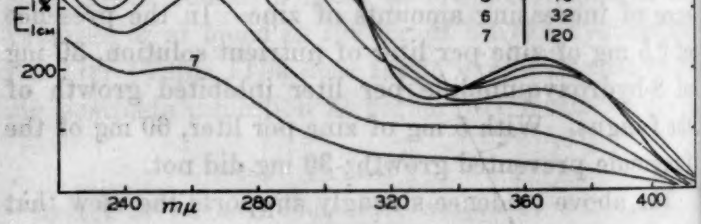

FIG. 3

Recently Totter and Day[12] reported that xanthopterin and "folic acid" concentrates counteract the leucopenia encountered in succinylsulfathiazole treated rats. They later reported[13] that xanthopterin delays the onset of nutritional cytopenia in monkeys and causes a certain hematopoietic response in cytopenic animals. The results of Totter and Day[12] prompted Mitchell[14] to point out that his "folic acid" concentrates may contain several per cent. of xanthopterin as an impurity, but the possibility of the presence of xanthopterin as a contaminant is not discussed in his more recent paper[3] in which he emphasizes the marked similarity of the absorption characteristics of xanthopterin to those of "folic acid" concentrates. The absorption data recorded by him indicate that his prepa-

[4] F. G. Hopkins, *Proc. Roy. Soc. B.*, 130: 359, 1942.
[5] R. Tschesche and H. J. Wolf, *Z. Physiol. Chem.*, 244: I, 1936; *ibid.*, 248: 34, 1937.
[6] R. W. Simmons and E. R. Norris, *Jour. Biol. Chem.*, 140: 679. 1941.
[7] B. L. O'Dell and A. G. Hogan, *Jour. Biol. Chem.*, 149: 323, 1943.
[8] C. Schöpf and E. Becker, *Ann.*, 507: 273, 1933; W. Koschara, *Z. physiol. Chem.*, 240: 138, 1936.
[9] R. Purrmann, *Ann.*, 546: 98, 1940.
[10] C. Schöpf and E. Becker, *Ann.*, 524: 49, 1936.
[11] We wish to thank Dr. G. W. Rawson of this laboratory for his assistance in collecting the insects during the summer of 1943 and for the species identification.
[12] J. R. Totter and P. L. Day, *Jour. Biol. Chem.*, 147: 257, 1943.
[13] J. R. Totter, C. F. Shukers, J. Kolsom, V. Mims and P. L. Day, *Jour. Biol. Chem.*, 152: 147, 1944.
[14] H. K. Mitchell, SCIENCE, 97: 442, 1943.

ration of xanthopterin was 50–60 per cent pure. The use of impure xanthopterin may account for recent conflicting reports concerning its role in nutrition.

The effect of ultraviolet irradiation upon the ultraviolet absorption of the vitamin is shown in Fig. 3. The irradiation was carried out with an H-4 lamp without filter for the periods of time indicated. Both the irradiation and corresponding absorption curves were made in aqueous solution (conc. = 0.002 per cent.) at pH 11. It is apparent that the compound is only moderately sensitive to ultraviolet illumination. Our purest specimens of the vitamin have a barely detectable trace of blue-green fluorescence in ultraviolet light. Since this fluorescence increases markedly on exposure to ultraviolet light, we can not be certain that the original very faint trace of fluorescence is not due to a decomposition product. We shall discuss the chemistry and biological activity of the irradiation products in a later paper.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A NEW DIFFERENTIAL STAIN FOR MOUSE PITUITARY[1]

THE need for a reliable and consistent differential stain for the pituitary gland of the mouse in certain experimental work provoked the search for such a method. The literature[2] on the mouse pituitary staining technique was studied and several methods were tried. The technique that was found to be most successful was a combination of several methods rather than any one method previously used. The combination method which has been developed is given in detail below.

(1) Fix tissues in modified Zenker-formol from six to twenty-four hours. Modified Zenker-formol contains only one half the normal amount of corrosive sublimate and one cc less than the normal amount of formalin.

(2) Wash in running water for twenty-four hours and then change to 50 per cent. alcohol for three hours.

(3) Change to 70 per cent. alcohol and leave overnight.

(4) Change to 80 per cent. alcohol for at least two hours or until needed.

(5) Change to 95 per cent. and 100 per cent. alcohols for an hour each.

(6) Change to a 1:1 mixture of 100 per cent. alcohol and xylol for twenty minutes, to xylol for forty minutes and to a 1:1 mixture of xylol and paraffin for twenty minutes.

(7) Change to 56°–58° paraffin for one hour and then embed.

The sections of the gland were cut at four micra and were then stained as follows:

(1) Carry sections from xylol through the alcohols to water in the usual manner, using iodine in the 70 per cent. alcohol to remove the corrosive sublimate crystals.

(2) Stain with haematoyxlin 15 to 20 seconds. (Mayer's haematoxylin was used).

(3) Rinse in water and then blue the sections in an aqueous solution of lithium carbonate.

(4) Stain the sections in a solution of picro-orange until they are even yellow. Picro-orange[3] consists of 0.25 gms of Orange G and 100 cc of 80 per cent. alcohol saturated with picric acid.

(5) Rinse in running water until only the red blood cells remain yellow.

(6) Stain in a 1:1 mixture of 1 per cent. ponceau de xylidine and 0.5 per cent. acid fuchsin as long as the red blood cells remain yellow, about 2 to 5 minutes. (Mcfarlane used ponceau red instead of ponceau de xylidine.)

(7) Rinse in 2 per cent. acetic acid in water.

(8) Differentiate to desired redness in a solution consisting of 40 cc of 95 per cent. alcohol, 20 cc of water and 40 cc of a stock solution. Stock solution includes 25 gms phosphotungstic acid, 2.5 gms picric acid and 100 cc per cent. alcohol.[4]

(9) Rinse in water.

(10) Stain for about 3 minutes in a solution of 100 cc of 2 per cent. Orange G in 1 per cent. phosphomolybdic acid.

(11) Rinse in water and transfer to a 1 per cent. aqueous solution of anilin blue for 15 to 20 minutes.[5]

(12) Rinse in water and dip quickly in 95 per cent. and 100 per cent. alcohols, clear in xylol and mount in balsam.

The technique described above gives results comparable to those of various triple stains on the pituitary glands of other animals. The acidophiles are orange to pink and their nuclei are reddish purple, the basophiles are an intense blue and the nuclei are pur-

[1] This work has been aided by grants from the Commonwealth Fund, Anna Fuller Fund, International Cancer Research Foundation, Jane Coffin Childs Memorial Fund and the National Advisory Cancer Council.

[2] Alexei Koneff, *Stain Tech.*, 13: 2, April, 1938; I. H. Perry and M. S. Lockhead, *Stain Tech.*, 15: 3, July, 1940; Miriam Reed, SCIENCE, 98: 2553; Earl B. Scott, *Stain Tech.*, 15: 2, April, 1940; Aura E. Severinghaus, *Anat. Rec.*, 53: 1, June, 1932.

[3] David McFarlane, *Stain Tech.*, 19: 1, January, 1944.

[4] *Idem.*

[5] C. R. Stockard and E. M. Vicari, *Amer. Anat. Memoirs*, No. 19, Sect. 5, 1941. Detailed suggestions from E. M. Vicari, unpublished material.

ple, and the chromophobes are colorless to very light blue and have purple nuclei.

In using the technique it is best to follow the sections rather closely with the microscope for a while to become accustomed to their appearance at various stages. One advantage of the technique is that if at any time too much stain has been removed the sections can be restained immediately without any further treatment. When using the stains on other tissues less time is necessary in the anilin blue solution.

This method may be used successfully after fixation in a modified Bouin's fluid (using only 1 cc of acetic acid instead of 5 cc) if the sections are mordanted before staining in a 3 per cent. potassium dichromate solution for at least 15 minutes.

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ACTION OF RADIOACTIVE SUBSTANCES ON THE SPEED OF GROWTH OF PENICILLIUM NOTATUM AND THE PRODUCTION OF A POTENT PENICILLIN[1]

WE have based our experiments on the principle that the radiations of minute amounts of radon, or other radioactive substances, have an exciting action on the growth of living substances in contrast with the radiation of larger doses of these radioactive substances which have a destroying power.

Furthermore, a fluorescent substance, for instance, fluorescein, excited by the presence of radioactive substances, emits a light vibration. This light is produced internally in the suspension. The action of small amounts of this light probably has an additional exciting power on living substances.

The radioactive sources used were porcelain tubes filled with emanating radioactive substances (radium). Through the porcelain wall of the tube the radon diffuses. Our cells were prepared for a daily production of about 7 micro curies.

The medium utilized for the culture of *Penicillium notatum* was the usual medium (slightly modified Czapek-Dox medium at PH 6).

For each series of experiments we have studied and compared the growth of the same strain of *Penicillium notatum*,[2] and also the inhibitory power of the penicillin secreted under the following different conditions:

I. Normal growth of *Penicillium notatum* at 24° C.
II. Growth in presence of radon. During the period of irradiation, radon and its short-lived daughter products (Ra A, B, C, C^1, C^2) are present.
III. Growth in presence of radon and a fluorescent substance (fluorescein).

For the control of potency of the penicillin secreted, we have used Heatley's assay method, as described in *Endeavor* of January, 1944. However, we have seeded our plates according to the method described by Thomas, Levine and Vitagliano.[3]

The microorganism tested was a 21-hour culture of *Staphylococcus aureus.*

Under these conditions the Petri dishes examined 24 hours later have shown that the peak of secretion of penicillin, for the irradiated culture, was obtained at least 2 or 3 days before that of the controls.

CONCLUSION

These experiments demonstrate the possibility of substantially decreasing the time required for the growth of *Penicillium notatum* and of obtaining an active penicillin, tested *in vitro,* in the presence of radon and its deposits.

We do not believe that these radioactive substances act through their chemical properties since they are present in negligible quantities. However, it seems reasonable to assert that this action is due to the radiations emitted by these substances. These radiations are Alpha, Beta, Gamma and Delta. As a major part of the radiated energy absorbed by the medium is due to Alpha particles, it seems probable that the observed effect is mainly due to this type of radiation. Experiments are being conducted in order to determine the relative importance in the effect produced by the different types of radiations.

The addition of a fluorescent substance to the medium in which radioactive substances are present improves noticeably the effects of these radioactive elements.

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CORPORATION

[1] We are very much indebted to Dr. Boris Veebrink, of the Physical Research Laboratories of Canadian Radium and Uranium Corporation, and to Mr. Julien Garbat, for their technical help.

[2] Received from the Northern Regional Research Laboratory of the U. S. Department of Agriculture.

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